All. 1 verbale 6

SELEZIONE N. 2024N34 - ORALE

ELENCO N. 1

- Descrivere le principali motivazioni per l'utilizzo di immagini multispettrali. Fornire eventuali esempi applicativi.
- Descrivere la progettazione e lo svolgimento di un rilievo con laser scanner terrestre.
- Evidenziare vantaggi ed eventuali criticità dei rilievi fotogrammetrici da drone con auto-calibrazione della fotocamera e discutere le azioni che è possibile intraprendere per ridurre gli effetti di tali criticità.

ELENCO N. 2

- Quali sono le principali caratteristiche del modello raster e del modello vettoriale in un GIS.
- Descrivere le tecniche di allineamento di nuvole di punti, con eventuale riferimento anche ai principali software per la gestione di nuvole di punti.
- Descrivere i possibili approcci implementabili per ottenere una ricostruzione 3D metrica tramite un rilievo fotogrammetrico. Evidenziare eventuali vantaggi e criticità di ciascun approccio.

ELENCO N. 3

- Descrivere i principali step del workflow di un'elaborazione fotogrammetrica, con eventuale riferimento ai principali software fotogrammetrici.
- Evidenziare vantaggi e svantaggi dei rilievi tramite laser scanner terrestre statico piuttosto che mobile.
- Descrivere le componenti di un GIS, le tipologie di dati le loro caratteristiche e i principali strumenti di analisi.

ELENCO N. 4

- Descrivere i principi base nella progettazione di un piano di volo per rilievo fotogrammetrico da drone.
- Descrivere le basi del meccanismo di funzionamento di un laser scanner terrestre.
- Descrivere le caratteristiche di un database topografico.

ELENCO N. 5

- Descrivere i possibili prodotti 2D e 3D di un rilievo fotogrammetrico.
- Descrivere i principali parametri di cui tenere conto nella progettazione di un piano di volo LiDAR.
- Evidenziare caratteristiche e differenze tra dati vettoriali e raster.

All. 1 verbale 6

Domande informatica Selezione 2024N34:

1. Esplicitare quali sono le finalità tipiche di un utente nell'utilizzo di un browser.

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2. Spiegare che caratteristica va a descrivere l'espressione "512 GB" riferita ad un disco fisso.

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3. Spiegare che caratteristica va a descrivere l'espressione "2.7 GHz" riferita ad una CPU.

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4. Quali sono le finalità tipiche di un foglio elettronico?

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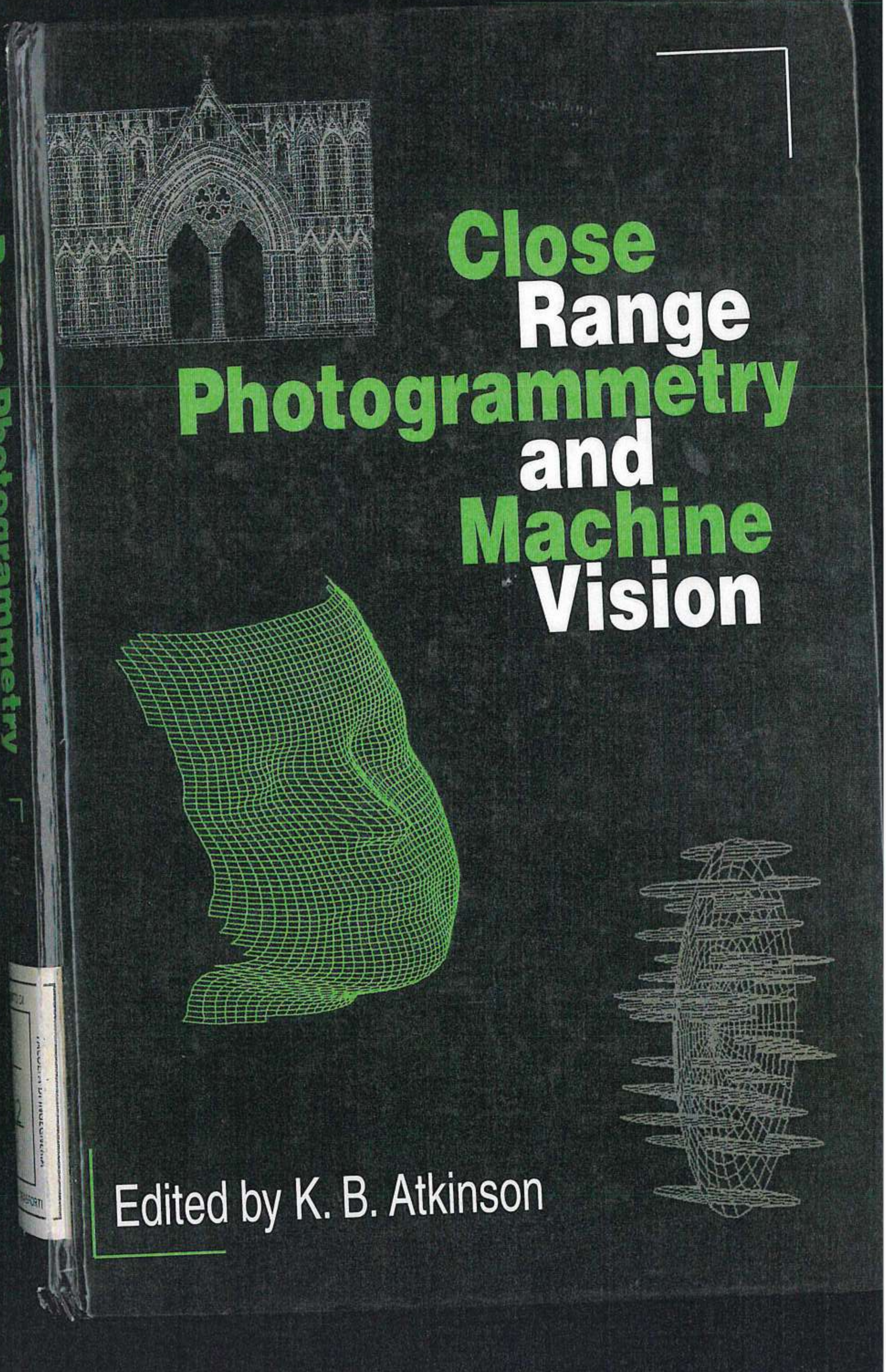
5. Quali sono le componenti hardware fondamentali di un calcolatore elettronico?


Close Range Photogrammetry
Close
Range
Photogrammetry
and
Machine
Vision
Edited by K. B. Atkinson

2 Theory of close range photogrammetry

M.A.R. Cooper with S. Robson

SISANI

Photogrammetry is a technique for obtaining information about the position, size and shape of an object by measuring images of it instead of by measuring it directly. The term 'close range photogrammetry' is used to describe the technique when the extent of the object to be measured is less than about 100 metres and cameras are positioned close to it. Other characteristics have come to be associated with close range photogrammetry which make it different from aerial mapping. Images are obtained from camera positions all around (and sometimes inside) the object (Figure 2.1). Camera axes are parallel only in special cases; usually they are highly convergent, pointing generally towards the middle of the object. The co-ordinates of points on the surface of an object are often required to be of high homogeneous accuracy throughout the object space. Based on an understanding of the physical processes of imaging and measurement, mathematical models are devised which form the basis of numerical methods to produce three dimensional co-ordinates of discrete points on the object. These co-ordinates are usually estimated by least squares, sometimes with thousands of degrees of freedom. One of the results of the increasing use of digital cameras for photogrammetry is the transfer of machine vision algorithms and concepts into photogrammetric processes. Image features can now be automatically identified, matched and transformed into three dimensional features in object space.

The results of close range photogrammetry must generally be made available very quickly after acquisition of the images so that they can be used for further processing related to the measured object and its function. Derived co-ordinates might be used for comparing the measured object with its designed size and shape in a test of conformance. Or they may be compared with a previous set of co-ordinates to detect deformation of the object. They are sometimes processed further using computer graphics, for example to produce a three dimensional CAD model of the object (Figure 2.1) and in a few cases drawn and dimensioned plans, elevations or sections may be required. Another significant characteristic of close range photogrammetry is the great diversity of measurement problems that can be solved using the technique. They call for a range of cameras, imaging media, configurations, photogrammetric procedures, methods of analysis and form of results to be considered and for specific instrumentation and techniques to be selected and used in each particular case to produce results that meet specifications (*see* Chapter 9).

The approach taken in this Chapter to give a theoretical basis for close range photogrammetry is now summarized. The reader is assumed to be familiar with basic statis-

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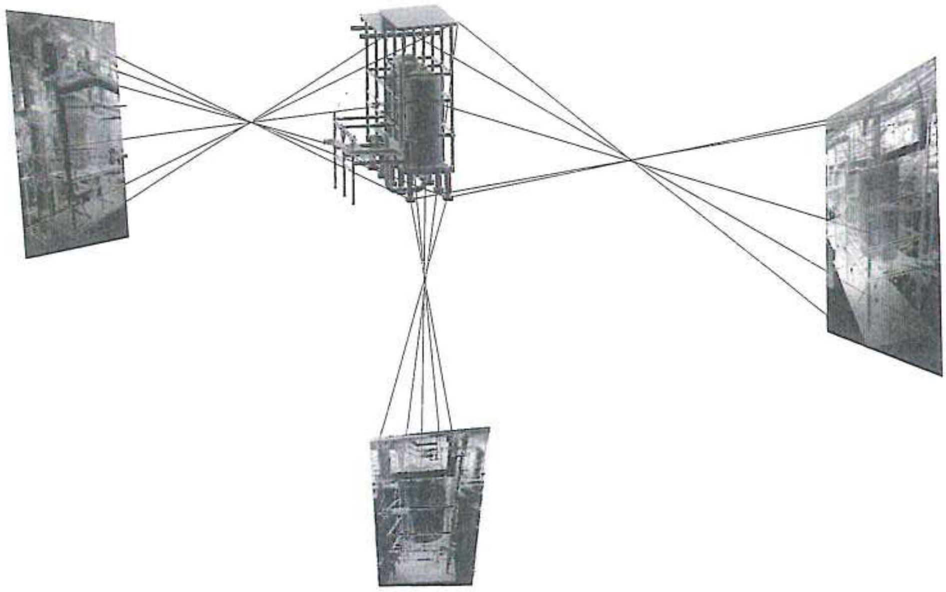

Figure 2.1 *Close range, multistation, convergent camera configuration. Only three of many cameras are illustrated.*

tics and matrix and vector algebra. Cartesian co-ordinates are convenient for defining positions of points, so co-ordinate transformations are discussed (section 2.1). A geometrical description of the complicated physical processes by which an image of a feature on the object is produced by a camera is described (section 2.2) followed by the geometrical relationships between two cameras and an object (section 2.3). The geometry of all cameras and an object is used (section 2.4) for deriving equations that are the basis of least squares estimation as a process for transforming measurements in the images into spatial information about the object. Theoretical and practical aspects of least squares estimation are discussed (section 2.5), and the Chapter ends with a consideration of indicators of the quality of data, whether measured or derived by least squares estimation (section 2.6). The general nature of the chapter means that few specific references are given. However, a bibliography is included so that the reader can find more information about the relevant principal subjects than has been possible to include here.

2.1 Co-ordinates and co-ordinate transformations

In photogrammetry the position of a point in space is commonly defined by a three dimensional cartesian co-ordinate system, the origin, scale and orientation of which can be arbitrarily defined. It is often necessary to convert between co-ordinates in systems having different origins, orientations and possibly scales. For example, in photogrammetry of a small industrial component it may be convenient initially to define co-ordinates of points on it with reference to a co-ordinate datum related to features on the

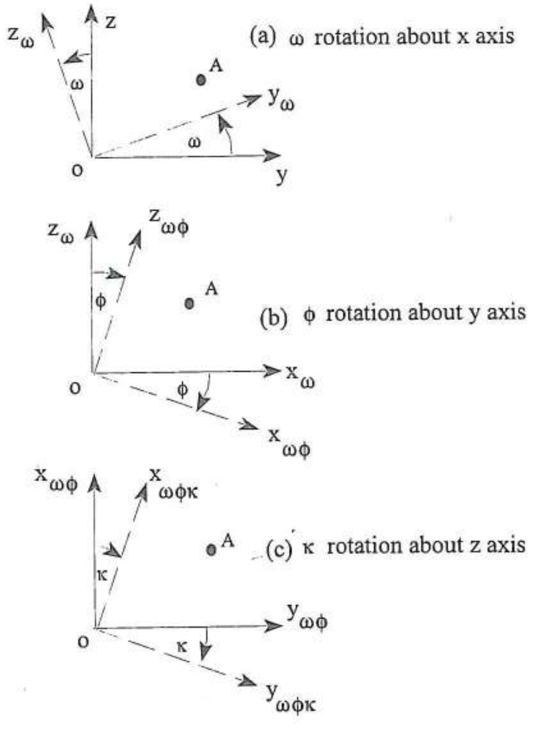

Figure 2.2 *Sequential rotations of axes in three dimensional space.*

object itself. If it is later relocated into a larger component, it may then be necessary to define co-ordinates of points on it relative to a new datum.

Co-ordinate transformations may be divided into three parts: scale change, translation and rotation. A scale change λ along each of the three axes may be represented by the vector equation $x = \lambda X$, where $\mathbf{X} = [X\ Y\ Z]^t$ is the position vector of a point in the primary co-ordinate system, and $\mathbf{x} = [x\ y\ z]^t$ is the position vector of the point in the secondary (scaled) co-ordinate system. A translation of axes may be represented by the vector equation $\mathbf{x} = \mathbf{X} - \mathbf{X}_o$, where $\mathbf{X} = [X\ Y\ Z]^t$, is the position vector of a point in the primary co-ordinate system, $\mathbf{X}_o = [X_o\ Y_o\ Z_o]^t$, is the position vector of the origin of the secondary co-ordinate system relative to the primary, and $\mathbf{x} = [x\ y\ z]^t$, is the position vector of the point in the secondary co-ordinate system.

2.1.1 Rotation matrices

Co-ordinate transformations arising from rotations of orthogonal axes in three dimensional space may be expressed as the resultant of three independent sequential transformations. Figure 2.2(*a*) shows a point A with co-ordinates (x, y, z) relative to the (xyz) axes. If a rotation ω is made clockwise about the (positive) x-axis, the position vector of A in the rotated system $(x_\omega y_\omega z_\omega)$ is given by the vector equation $[x_\omega\, y_\omega\, z_\omega]^t = \mathbf{R}_\omega [x\ y\ z]^t$ where